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Improving agricultural inventories of GHG emissions: A UK case study

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Introduction

The UK is committed to ambitious targets to reduce greenhouse gas emissions. Under the Climate Change act of 2008 there is a long-term legally binding requirement to reduce national emissions by at least 80% below the 1990 baseline by 2050, with interim reductions of at least 34% by 2020. Agricultural emissions made up 9% of the total greenhouse gas emissions in 2014, and these are associated with some of the highest uncertainties in national inventory reports (DECC 2016). For this reason a large programme of research has been undertaken in the UK in order to reduce uncertainties associated with agricultural greenhouse gas reporting and to support the development of mitigation actions. This has involved a co-ordinated programme of research to quantify emissions of nitrous oxide from fertilisers and livestock wastes, and enteric methane emissions, the Greenhouse Gas Platform. Work is also being undertaken to improve reporting of greenhouse gas emissions and removals from the Land Use Land Use Change and Forestry sector. Highlights of this research and the implications for national inventory reporting are presented.

Materials and Methods

Nitrous oxide emissions were measured from the range of nitrogen sources that are added to soils under contrasting soil and climatic conditions across the UK. Experiments used standard protocols for experimental design, measurements, data handling and statistical analysis. Measurements of methane emissions from livestock (focusing on cattle and sheep) were used to generate Emission Factors that were representative of different breeds and systems and assess the effect of nutrition (basal forages, concentrates supplements and feed additives). A parallel process of verification and modelling of the data obtained from these research activities was undertaken. Greenhouse gas emissions are also reported from Land Use, Land Use Change and Forestry (LULUCF). IPCC guidelines (IPCC, 2006) are currently used to report emissions resulting from land use change and a study is being carried out to determine whether this reporting can be extended to include cropland and grassland management.

Results and Conclusions

Greenhouse gas emissions from agriculture have remained relatively constant over the past five years, despite significant reductions of emissions in other sectors (Table 1). This places increased pressure agriculture to reduce emissions if overall emission reduction targets are to be met.



Table 1. UK greenhouse gas emissions from agriculture (Mt CO_{2e}) National Inventory Report).

| | 1990 | 1995 | 2000 | 2005 | 2010 | 2013 | 2014 |
|----------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| Carbon dioxide | 7.0 | 7.1 | 5.7 | 5.6 | 5.2 | 5.3 | 5.3 |
| Methane | 32.6 | 32.0 | 30.8 | 28.7 | 27.2 | 27.0 | 27.4 |
| Nitrous oxide | 19.2 | 19.0 | 18.0 | 16.6 | 15.9 | 15.8 | 16.3 |
| Total | 58.7 | 58.1 | 54.6 | 50.9 | 48.3 | 48.1 | 49.1 |

The Greenhouse Gas Platform research has provided improved understanding of emissions from agricultural sources. The observed nitrous oxide Emission Factor (EF1 is the proportion of N₂O derived from a nitrogen source) for fertilisers applied to grasslands was 1.3 %, however, the Emission Factor for fertiliser applied to arable crops ranged between 0.5-0.8 % (depending on the nitrogen source) which is below the 1% Tier 1 default value. Nitrous oxide emissions from grazing returns by cattle were also significantly lower than default IPCC values with Emission Factors from dung of 0.2%, and urine of 0.7%, giving a combined weighted Emission Factor of 0.5% (as compared with the default Emission Factor from these sources of 2%). These new Tier 2 nitrous oxide Emission Factors are currently being applied to the UK's inventory reports increasing the relative importance of methane as a greenhouse gas (Fig. 1).

Enteric methane emissions from beef cattle and sheep, showed a limited effect of breed and breed type on emissions. There was a much greater effect of diet type, with animals consuming more higher-quality (lowland) forage than poorer-quality (upland) forages and consequently producing more methane each day on the better quality feeds. This research provided validation of the Tier 2 Emission Factors used to report methane emissions from UK livestock.

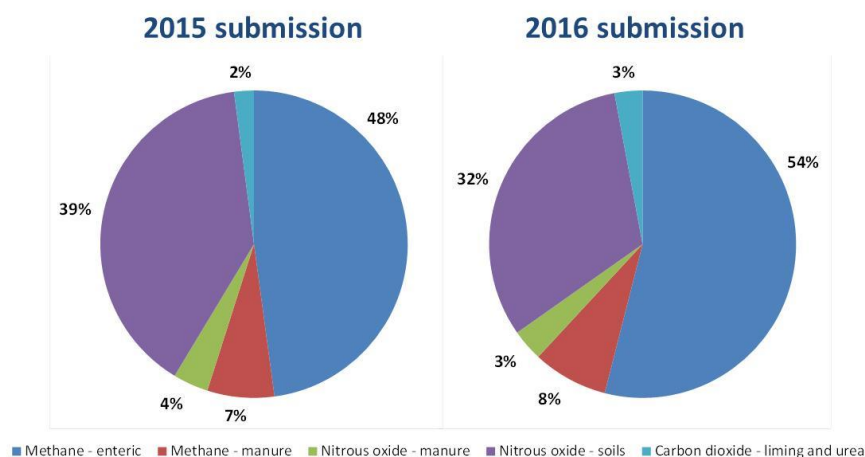


Figure 1. Relative importance of UK agricultural greenhouse gases in inventory reports for 2015 and 2016.



Greenhouse gas emissions from Land Use, Land Use Change and Forestry were responsible for an annual uptake of 9 Mt CO_{2e} in 2014, mostly from the forestry sector. Research is currently being undertaken to establish opportunities to report carbon sequestration by the management of grasslands remaining grasslands and croplands remaining croplands. Early indications would suggest that this will have only a minor impact on overall greenhouse gas emissions and removals from the agriculture and LULUCF sectors.

This research highlights the importance of the non-CO₂ greenhouse gases in contributing to emissions from agricultural production, and provides improved opportunities to mitigation actions that will deliver further emissions reductions.

References

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